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SATURN'S ROTATION RATE

The planetary radio astronomy experiment aboard the two Voyager spacecraft has determined the rotation rate of Saturn to be 10 hours, 39.4 minutes ±9 seconds. Such a precise measurement was not possible before for several reasons. Previous outer planet spacecraft did not carry instrumentation required for obtaining the data. Also, the measurements are impossible from Earth because of the great distance (8.54 astronomical units) and the fact that Saturn's peak radio emissions fall in the standard AM radio broadcast band used on Earth. Previous measurements by ground-based astronomy have measured the rotation of Saturn's clouds, not the rotation of Saturn itself.

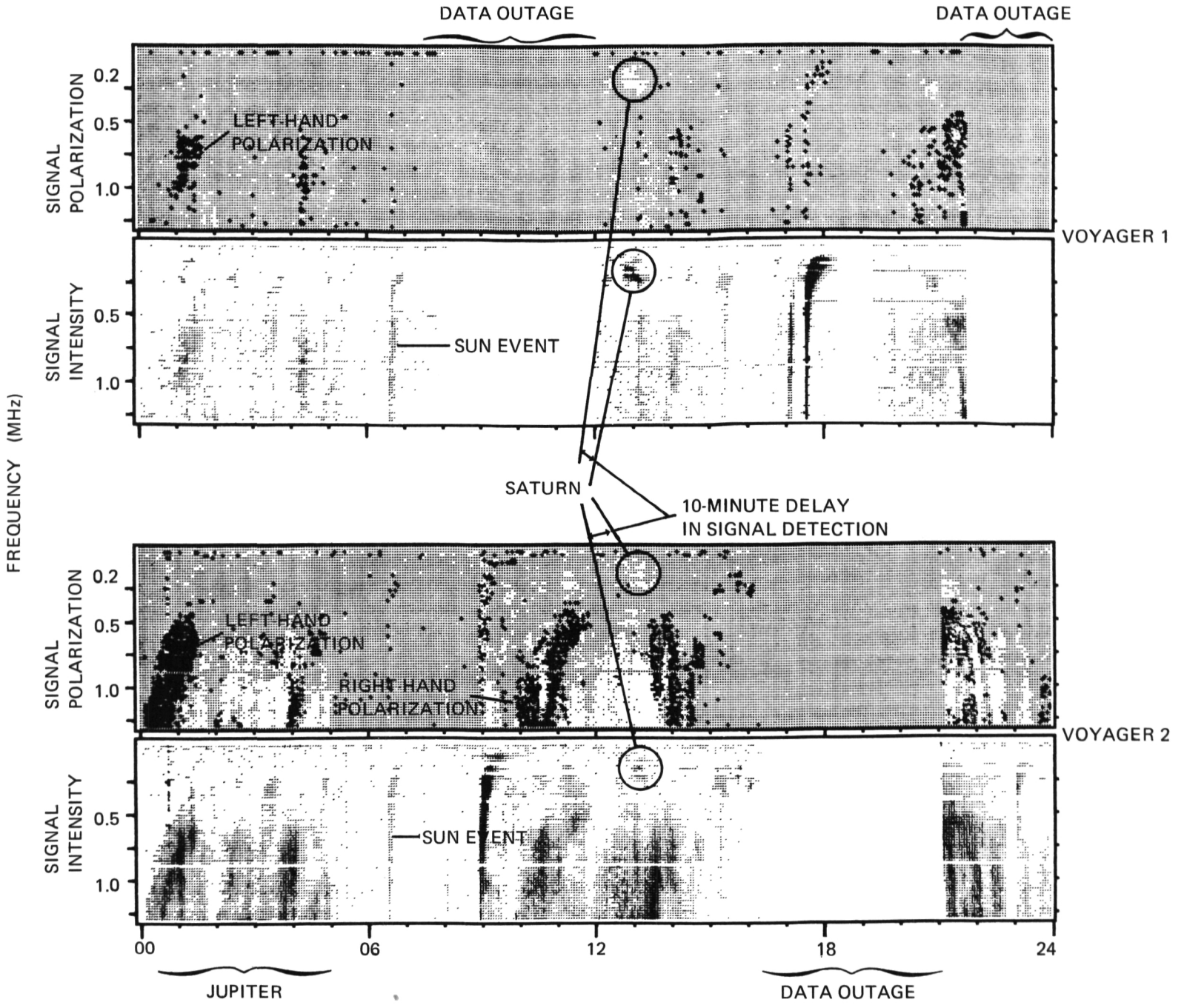
Correlation of data acquired by both spacecraft shows cyclical bursts of non-thermal radio noise from Saturn at regular intervals of 10 h, 39.4 min. The noise frequency is near 200 kilohertz, and the radiation is right-hand polarized. It most likely is emitted in the extraordinary magnetoionic mode from Saturn's northern hemisphere.

The emissions were distinguished by several criteria from Jupiter's bursts, from solar type III bursts, and from background noise. First, only the signals that were stronger for Voyager 1 were counted because that spacecraft was closer to Saturn than Voyager 2. Secondly, the light-time delay of 10 min between the Voyagers also was used to identify the right signals. Finally, the spectral character and polarization of the Saturn events are distinct from solar type III bursts and the Jovian emissions.

The initial rotation rate determination was based on a survey of 33 events totaling 24.5 h of activity over 40 days. Subsequent measurements refined the rate by 0.5 min.

The ability to determine a rotation period implies a deviation from perfect axial symmetry of the planetary magnetic field.

Figure (*opposite page*): The Saturn rotation rate was determined by interpretations of a large number of plots similar to the one shown. The four rectangles contain typical plots of radio signals from Saturn, Jupiter and the sun as received by the two Voyager spacecraft in the indicated 24-hour period. The white background plots show intensity signals while the gray ones show the corresponding polarizations. In the gray polarization plots, left-hand polarization is shown as black, right hand as white. Typical Jovian emissions and solar bursts are indicated. Saturn emissions are circled. The Saturn emissions repeat every 10 hours, 39.4 minutes to give the rotation rate of the planet's core. The Jupiter emissions repeat every 9 hours, 55.5 minutes, and the solar events are unpredictable. Some data outages are shown for both spacecraft.


DATA OUTAGE
DATA OUTAGE
SIGNAL POLARIZATION
0.2
0.5
1.0
LEFT HAND POLARIZATION
VOYAGER 1
SIGNAL INTENSITY
0.5
1.0
SUN EVENT
FREQUENCY (MHz)
SATURN
10-MINUTE DELAY IN SIGNAL DETECTION
SIGNAL POLARIZATION
0.2
0.5
1.0
LEFT HAND POLARIZATION
RIGHT HAND POLARIZATION
VOYAGER 2
SIGNAL INTENSITY
0.5
1.0
SUN EVENT
00
06
12
18
24
JUPITER
DATA OUTAGE